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Document Title **Specification for the Calorimeter Photodiode Flexible Cable**		

Gamma-ray Large Area Space Telescope (GLAST)

Large Area Telescope (LAT)

Specification for the Calorimeter Photodiode Flexible Cable

(Conceptual, Ver 1)

DOCUMENT APPROVAL

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes	DCN #
1		Initial Release	

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1 PURPOSE

This document specifies the mechanical and electrical characteristics of the flexible circuit board (kapton cable) interconnect between the PIN photodiode assembly and the analog front end electronics board (AFEE) for the Calorimeter subsystem of the GLAST Large Area Telescope (LAT).

2 SCOPE

These specifications apply to the prototype flex cables designed for the Calorimeter subsystem of the GLAST LAT. The prototypes shall be designed, fabricated and tested in the Engineering Model (EM) of the calorimeter subsystem. Approximately 250 flex cables shall be delivered for the Engineering Model. Subsequent to the testing of the prototype cables and EM, this specification shall be modified to detail the final design, fabrication, testing and documentation for the diode flex cables for the GLAST flight instrument. Approximately 4400 flex cables shall be purchased for the flight instrument and spares.

This release of the specification applies to the Engineering Model prototype diode flex cable assemblies only. The diode flex cables shall be manufactured, to the extent possible, with identical materials and processes as the flight instrument cables but with documentation and quality assurance procedures more commensurate with commercial fabrication procedures. The details of the manufacturing and quality controls for the flight procurement shall be in accordance with the Association Connecting Electronics Industries (IPC) specifications for flexible circuits.

3 DEFINITIONS

3.1 Acronyms

CAL	The Calorimeter subsystem of the LAT
GLAST	Gamma-ray Large Area Space Telescope
EM	Engineering Model
FM	Flight Model
GSFC	Goddard Space Flight Center, NASA
IPC	Association Connecting Electronics Industries
LAT	Large Area Telescope
NASA	National Aeronautics and Space Administration
ZIF	Zero Insertion Force
TBR	To Be Resolved

3.2 Definitions

γ	Gamma Ray
usec, us	microsecond, 10^{-6} second
nm	Nanometer
μm	Micrometer
mm	millimeter
cm	centimeter

4 APPLICABLE DOCUMENTS

Documents that are relevant to the development of the GLAST LAT Calorimeter and its requirements include the following:

LAT-SP-00010	"GLAST LAT Performance Specification", August 2000
LAT-SS-00018	"LAT CAL Subsystem Specification", January 2001
GLAST00110	"Mission Assurance Requirements (MAR) for Gamma-Ray Large Area Telescope (GLAST) Large Area Telescope (LAT)", NASA Goddard Space Flight Center, Current Draft Sept 20, 2000

LAT-DS-00209	Specification for the Calorimeter PIN Photodiode Assembly
NPD 8010.2B	"NASA Policy Directive, Use of Metric System of Measurement in NASA Programs"
Hamamatsu Photonics K03-B70065	Specification for the Silicon PIN photodiode, S3590 SPL 2CH, dated 6 August 1998.
MIL-PRF-19500	Performance Specification for Semiconductor Devices
MIL-STD-750	Test Methods for Semiconductor Devices
EIA-625	Requirements for Handling Electrostatic Discharge Sensitive Devices (ESDs)
IPC-FC-231	Flexible Base Dielectrics for Use in Flexible Printed Wiring.
IPC-FC-232	Adhesive Coated Dielectric Films for Use as Cover Sheets for Flexible Printed Wiring and Flexible Bonding Films
IPC-FC-241	Flexible Metal Clad Dielectrics for use Flexible Printed Wiring
IPC-FA-251	Assembly Guidelines
IPC-MF-150F	Metal Foil for Printed Wiring Applications
IPC-6013	Qualification and Performance Specification for Flexible Printed Wiring Boards
IPC-2223	Design Standard for Flexible Printed Wiring Boards
MIL-C-55302/65	Requirements for Connector and other applicable documents specified in NR documents
NASA-STD-8739.3	Soldered Electrical Connections

5 INTRODUCTION

The LAT calorimeter is a hodoscopic array of 96 CsI(Tl) scintillation crystals. Scintillation light is collected by PIN photodiodes at the crystal ends and processed by charge sensitive preamplifiers on adjacent circuit boards. The flex cable provides electrical connection between each individual diode and its associated preamplifier. The flexible interconnect supports mechanical considerations of the connection including crystal thermal expansion and launch vibration.

The diode at each crystal log end is actually two diodes mounted in the same ceramic carrier. The combination of a large and small diodes supports the large dynamic range of signals expected. Figure 1 shows the general arrangement of the PIN Photodiode assembly. The flexible printed circuit connects the PIN photodiode assembly to the analog front-end electronics circuit card. This specification addresses the requirements and design of this cable.

6 REQUIREMENTS

6.1 Kapton Cable i.e., Flexible Printed Wiring Board as per IPC-6013

6.2 Specification

Material type and construction is extremely important in designing flexible printed wiring. All materials shall be specified on the master drawing. For clarification, it is suggested that cross-sectional views be used to highlight material selection.

At the fabricator's option, flexible metal clad dielectrics and adhesive coated dielectric films may be manufactured using individual components per IPC-MF-150, IPC-FC-231, IPC-FC-232, and IPC-FC-241.

6.2.1 Kapton Cable

The mechanical configuration of the kapton (polyamide) cable is specified in Figure 2. The cable shall be soldered to the pins of the ceramic carrier.

The cable length is chosen shall be 2.5 cm (TBR).

6.2.2 Kapton

The kapton ribbon shall be constructed from 1 mil (25 µm) thick (minimum) base material with a 1 mil (25µm) thick (minimum) cover enclosing the conductive layer.

6.2.3 Conductors

Four copper conductors shall provide individual paths for the cathode and anode of each diode. One ounce rolled, annealed, copper foil shall be used for the conductors (thickness, ~1.4 mil or 35 µm) per IPC-MF-150F. Exposed copper surfaces (pads) shall be covered with tin/lead or gold plating. Minimum thickness of tin/lead plating shall be 0.4 mil. Minimum thickness of gold plating shall be 10um.

6.2.4 Adhesives

Adhesives that bond the copper foil to the base material and the cover material shall be ~1 – 1.5 mil thick. Adhesive that bonds reinforcing films to the base material shall be ~ 1 – 1.5 thick per IPC-FC-232.

For EM parts, adhesion strength shall meet IPC class 2 requirements. This issue will be further investigated for FM parts.

6.2.5 Cable End Design – Ceramic Carrier Connection

The termination at the PIN diode end shall be soldered pin connection. The cable end is stiffened using normal flex cable procedures to provide stress relief for thruhole solder pads. The stiffener shall be constructed as shown in Figure 2. Kapton is removed from both sides of the through hole pads, providing solder bonding area. The holes in the conductor for the carrier connection shall be plated thruholes with finished diameter (~ 0.9 mm), sufficient to provide clearance around the bottom fillet of the kovar pin for flush mounting of the cable. Solder pads shall be tin/lead plated with minimum plating thickness of 0.4 mil.

6.2.6 Cable End Design – Electronics Board Connection

The termination at the circuit board end shall be for a Zero Insertion Force (ZIF) flex connector. . The flex cable is sheared where indicated on the silkscreen marking, to make these pads accessible for the flight connection. The cable end is stiffened using normal flex cable procedures to provide connection to a bottom contact flex connector. One layer of the kapton is removed around these interconnects to expose the connection pads. The connection pads shall be gold plated with minimum thickness of plating 10um. Each cable pad will make contact with two contacts of the connector. The end of the cable shall be reinforced as shown in Figure 2. The connection stiffening shall result in a ~0.31 mm thick flex cable at the connector pads

6.2.7 Cable End Design – Test Connection

The termination for initial tests shall be for a ZIF flex connector. The cable end is stiffened using normal flex cable procedures to provide connection to a bottom contact flex connector. One layer of the kapton is removed around these interconnects to expose the connection pads. The connection pads shall be tin/lead plated with minimum thickness of plating 0.4 mil. The end of the cable shall be reinforced as shown in Figure 2. The connection stiffening shall result in a ~0.25 mm thick flex cable at the connector pads.

6.2.8 Shielding

There shall be no conductive shielding layers in the cable.

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6.2.9 Kapton cable attachment – Ceramic Carrier Conection

The kapton cable shall be soldered to the base of the kovar pins on the ceramic carrier such that the top of the cable is less than 0.8 mm from the ceramic. Gold plating on all surfaces that become part of finished solder connections shall be removed by two or more successive tinning operations (solder pot or iron), or by other processes demonstrated to have equivalent effectiveness.

All solder used for tinning and solder connections shall conform to ANSI/J-STD-006. Flux-cored solder shall be either composition SN60 or SN63 containing flux types R or RMA, or equivalent. For all soldering applications where adequate subsequent cleaning is not practical, only solder containing flux type R shall be used. Solid solders (no flux) for use in solder pots shall be of the same composition.

For the prototype diodes, the pins shall not be cut after soldering of the kapton cable. (It is likely that the vendor shall be required to cut the excess length of the pins after soldering for the flight units.)

6.2.10 Kapton cable attachment – Electronics Board Conection

The kapton cable shall be connected to a ZIF flex connector for flight. The number of mating cycles with the electronics board ZIF connector is to be minimized. Connection is made with the intent of last connection. The connector ZIF lever is epoxied closed for flight. The ZIF connector used is an 8 contact, 1.0 mm pitch, bottom contact connector with contact pins gold plated.

6.2.11 Kapton cable attachment – Test Conection

The kapton cable extension end shall be connected to a ZIF flex connector for testing purposes. The ZIF connector used is a commercial 8 contact, 1.0 mm pitch, bottom contact connector with tin/lead plated contacts. Possible parts are as follows:

Manufacturer	Part Number
Tyco / Amp	487952-8
Molex	52271-0890
FCI	SFW8R-1STE1

Table 1 Commercial ZIF flex connectors.

6.2.12 Vendor Selection

6.3 Materials Selection

6.4 Process Control

6.5 Qualification

6.6 Acceptance Testing

6.7 Environmental Requirements

6.8 Coupon Selection

6.9 Solderability Requirement

7 QUALITY SYSTEM AUDITS AND CONTROLS

8 CONTROL OF PURCHASES

8.1 Manufacturing Controls

8.1.1 Drawings and Specifications

8.1.2 Production Process and Fabrication

8.1.3 In Process Inspection

8.1.4 Process Controls

8.1.5 Final Inspection and Configuration

8.1.6 Testing

8.1.7 Handling and Storage

8.1.8 Preservation, Marking, Labeling, Packaging and Packing

Finished assemblies shall be packed and shipped in protective electrostatic shielding containers.

9 END ITEM DATA PACKAGE

9.1 Customer Source Inspection

9.2 Nonconformance Control Board

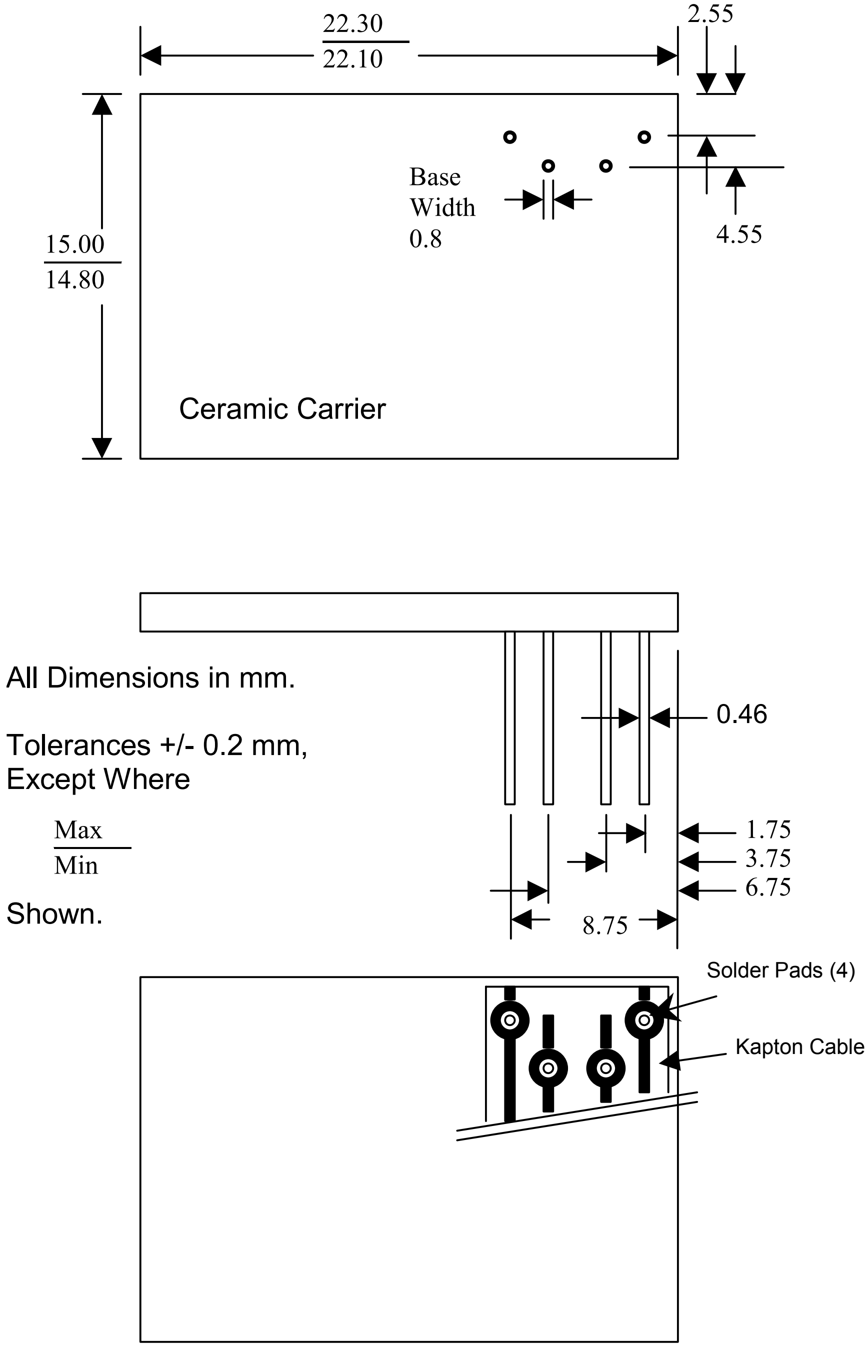

Figure 1. Mechanical Configuration of the GLAST CAL PIN Diode to Flex Cable Connection.

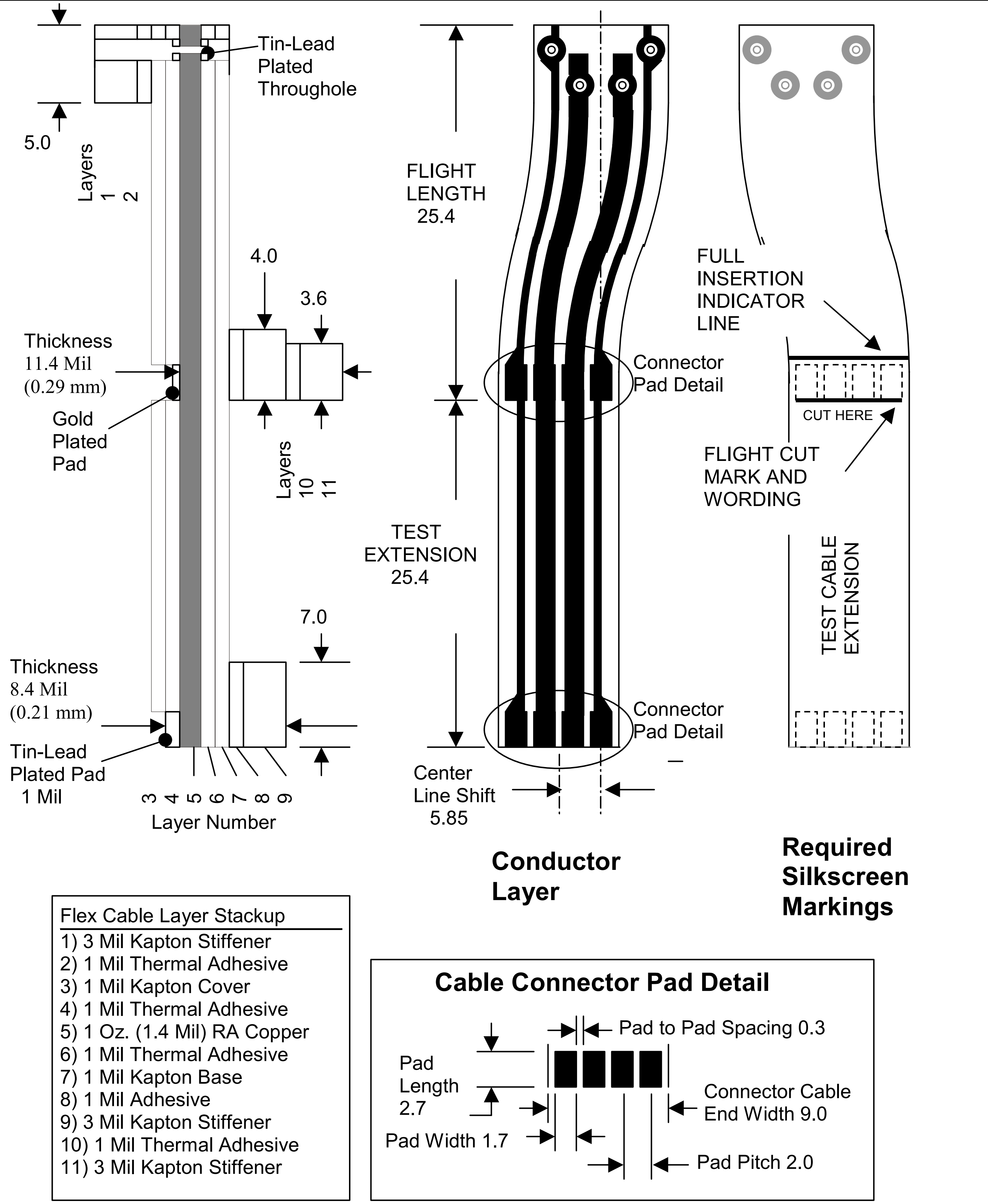

Figure 2. Mechanical Specification for Kapton Interconnect

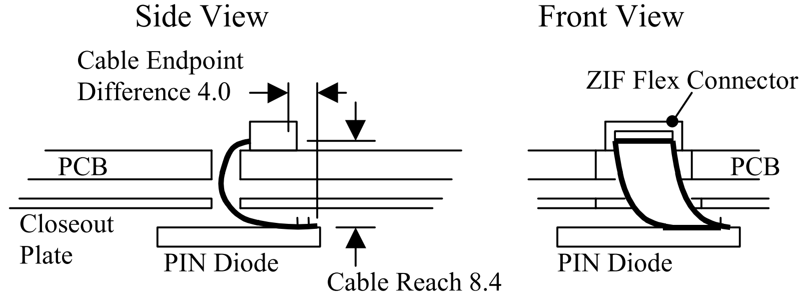

Figure 3. Installed flight geometry of the of the GLAST CAL PIN Diode Flex Cable.